Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-01	DPS
DPS-01	**GMT:** Prelaunch		**SPR** 28RF01	**UA**	**Manager:**
			IPR 32RV-0012	**PR**	
					Engineer:

Title: Input/Output Errors Logged Against Mass Memory Unit 1 During OPS 1 Transition. (ORB)

Summary: DISCUSSION: During the transition from Guidance, Navigation and Control (GNC) OPS 9 (G9) to GNC OPS 1 (G1) at T-20 minutes (220:11:25 G.m.t.) two input/output (I/O) errors were logged against mass memory unit (MMU) 1. The MMU 1 status register (MMU STAT B = 4000) indicated that a "Read-Tape-Data" dropout had occurred. The transition to G1 was completed using software from MMU 2 (after two errors on the prime MMU, any MMU operation is automatically attempted on the secondary MMU). The general purpose computers (GPC's) were transitioned back to G9 and a GPC memory (GMEM) update was performed to access G1 from area 2 of MMU 1. The subsequent G1 transition was successful with no further errors logged against the MMU. In addition, both the GNC OPS 2 (G2) transition and the GNC OPS 3 (G3) freeze dry were successfully loaded from area 1 of MMU 1.

Ground turnaround activities on MMU 1 have included 4 complete dumps, a purge of the classified flight software (consisting of 3 writes and a read) and a write of STS-32 OI8C Reconfiguration 1 flight software. No errors occurred during any of these procedures. CONCLUSION: This failure scenario is indicative of transient contamination on the MMU tape. Although this failure has not been seen on previous flights, it has occurred on several occasions during ground turnaround. Unfortunately, when the failure has not been duplicated, the vendor has not been able to positively identify the cause. In these cases, the units were cleaned and returned to flight status (this procedure usually take 6 to 9 months at a cost of approximately 200K). Therefore, MMU 1 (S/N PD13 will remain in the vehicle and no further action will be taken. CORRECTIVE_ACTION: None, fly as is. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:05	Problem	**FIAR**	**IFA** STS-28-V-02	CREW
MMACS-02	**GMT:** 220:12:42		**SPR** 28RF02	**UA**	**Manager:**
			IPR 32RV-0014	**PR**	

Engineer:

Title: Pilot's Seat Moved During Ascent (ORB)
<u>Summary:</U> DISCUSSION: During second stage flight, the Commander and Mission Specialist noticed the pilot's seat moving aft. After the Pilot repositioned the seat, the seat immediately began to drift back to the rear hard stops. During entry, the seat functioned properly. During troubleshooting at KSC, the audible brake release was heard, and the motor did not come to a hard stop when power was removed. When the motor/brake assembly was removed, the brake torque was found to be zero. The brake torque should be 9-13 in-oz.

A preliminary failure analysis at the vendor showed that the brake pad was debonded from the non-rotating plate, and the brake-pad-to-plate adhesive from all appearances had flowed, indicating the presence of high temperatures. Also, the screw that retains the rotating brake mechanism was fully backed out and one quarter of its threads were worn away. The Locktite temperature limit is 325?F and the discoloration of components indicated temperatures above 500?F. This unit was exposed to a more severe environment than any other motor/brake assembly in the fleet. This motor/brake assembly was originally used for qualification testing, then in the one "g" trainer, and recently at Wright-Patterson Air Force Base for vibration testing, after which it was returned to flight use. CONCLUSION: This motor/brake assembly failure is considered an isolated event based on the unique history of this assembly. This motor was designed for intermittent operation; however, during qualification testing, the motor/brake was subjected to continuous operation for 300 cycles. The higher temperatures generated by this test caused deterioration of the brake pad bonding and brake-shaft-screw Locktite. Subsequent vibration testing caused the brake shaft screw to back out. Previous refurbishment requirements failed to require inspection of the motor/brake assembly prior to reuse for flight. CORRECTIVE_ACTION: The motor/brake assembly has been replaced. An OMRSD/OMI revision is being developed to insure a proper audible brake release when power is applied, and proper brake engagement when power is removed. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:02:06	Problem	**FIAR**	**IFA** STS-28-V-03	OMS/RCS
PROP-02	**GMT:** 220:14:43		**SPR** 28RF03	**UA**	**Manager:**
			IPR 32RV-006	**PR**	
					Engineer:

Title: Forward Reaction Control Subsystem Vernier Thruster F5R Failed On-Orbit (ORB)

Summary: DISCUSSION: The forward Reaction Control Subsystem (RCS) vernier thruster F5R was annunciated "Fail Leak" while on-orbit and was deselected by RCS redundancy management (RM). In-flight data indicate an oxidizer leak large enough to cause propellant to freeze and temporarily plug the nozzle. The forward vernier manifold was closed to isolate the leak and this caused the loss of vernier attitude control for the entire mission. The primary thruster system was used for attitude control during the remainder of the mission, and this resulted in a higher than planned forward and aft RCS propellant usage. A thruster nozzle plug was inserted and a manifold drain procedure was performed at Dryden Flight Research Facility prior to the ferry flight.

CONCLUSION: The most probable cause of the RM announced leak indication on the F5R thruster was an oxidizer pilot valve stuck partially open because of contamination. CORRECTIVE_ACTION: The forward pod will be removed and the F5R thruster will be removed and replaced and sent to the vendor for failure analysis. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-04	MECH
MMACS-01	**GMT:** Prelaunch		**SPR** 28RF04	**UA**	**Manager:**
			IPR	**PR** GNC-2-A-0008	
					Engineer:

Title: Weight on Nose Gear Indication Failed Prelaunch. (ORB)

Summary: DISCUSSION: The nose landing gear no-weight-on-wheels (NOWOW) 1 indication went of OFF during the prelaunch period at 218:18:38 G.m.t. This indication was not a violation of the Launch Commit Criteria, and the decision was made to fly-as-is. The indication recovered on-orbit, but subsequently failed again prior to landing.

The NOWOW 1 and NOWOW 2 indications are generated by proximity sensors on the nose gear and are used by flight software to mode several display and flight control functions (including nosewheel steering) to rollout phase. Should the indications disagree the software annunciates a dilemma. A manual backup procedure is available to the crew by depressing either the ET SEP or SRB SEP pushbuttons which the software recognizes as the same function. As expected, a dilemma occurred at touchdown and normal crew backup procedures were used to enable nosewheel steering and other rollout functions. Troubleshooting at KSC revealed that the proximity sensor was functioning properly and that the fault was in landing gear proximity sensor electronics box number 1 which is located in avionics bay 1. This unit was removed and replaced. The faulty unit was sent to the vendor for failure identification. CONCLUSION: The anomaly resulted from a faulty proximity sensor electronics box number 1. The specific cause is pending fault identification within the unit and failure analysis, if required. CORRECTIVE_ACTION: Corrective action will be documented on CAR 28RF04. EFFECTS_ON_SUBSEQUENT_MISSIONS: Should failure recur on subsequent missions, recovery is available via normal crew backup procedures.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-28-V-05	OI - Sensors
A) BSTR-01, B) PROP-01,	**GMT:**		**SPR** A) 28RF10, B)	**UA**	**Manager:**
C) EECOM-03, D) BSTR-			28RF05, C) 28RF06, D)	**PR** B) RPO4-A0016	

02,			28RF13, E) 28R **IPR** A) 32RV-0007, D) 32RV-0008, E) 32RV-0026	**Engineer:**

Title: Operational Instrumentation Failures (ORB)

Summary: DISCUSSION: a) SSME 2 LH2 inlet temperature failed offscale high during ascent (V41T1201C). KSC has removed and replaced failed transducer. Failure analysis will be tracked by CAR 28RF10. This is a criticality 3 measurement. This problem is closed.

b) Right RCS oxidizer helium tank pressure #1 failed (V42P3110C). Prelaunch, the pressure measurement was erratic. On orbit, the measurement difference between P1 and P2 decreased. KSC has removed and replaced the failed transducer. Failure analysis will be tracked by CAR 28RF05. This is a criticality 3 measurement. This problem is closed. c) Fuel Cell #1 H2 flowmeter output began to drift high at M.E.T. 12:30 and exhibited subsequent erratic behavior with intermittent upper limit indications. It has been determined acceptable to fly as is. KSC will submit exception. This is a criticality 3 measurement. This problem is closed. d) During ascent, the GH2 outlet temperature measurement (V41T1361A) was erratic. KSC has removed and replaced the failed transducer. This is a criticality 3 measurement. Failure analysis will be tracked by CAR 28RF13. This problem is closed. e) Supply water tank B quantity measurement (V62Q0420A) experienced data dropouts on orbit. All postlanding test results show that the orbiter hardware is working properly. This is a criticality 3 measurement. This problem is closed as inadvertent listing as an IFA through misidentification of data dropouts as a spacecraft transducer problem. f) During the STS-28 mission it was determined that the following five OI measurements are transmitting data. These measurements should not be connected (DFI to OI conversion) but still read unknown measurements. 1. V58T0130 - system #1 - LH2 retract actuator return line readout 2. V58T0169 - system #1 - Body flap return line readout 3. V58T0269 - system #3 - Body flap return line readout 4. V58T0369 - system #3 - body flap return line readout 5. V58T0384 - system #3 - RSB hydraulic return line readout It has been determined that it is technically acceptable to fly these measurements as is. An Orbiter and GFE Projects Office decision has been made to fly as is. This problem is closed. CONCLUSION: See above. CORRECTIVE_ACTION: See above. EFFECTS_ON_SUBSEQUENT_MISSIONS: See above.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-06	D&C - Lighting
EECOM-02	**GMT:** Prelaunch		**SPR** 28RF07	**UA**	**Manager:**
			IPR 32RV-0004	**PR**	
					Engineer:

Title: ABORT Light B Did Not Illuminate During Prelaunch Test. (ORB)

Summary: DISCUSSION: During prelaunch Abort Advisory checks at 220:01:40 G.m.t., the "B" lamps in the ABORT annunciator on panel F6 did not illuminate. The

ABORT annunciator contains four lamps. The two on the B side are driven by Annunciator Control Assembly (ACA) 2. The A side is driven by ACA 1. During troubleshooting, a lamp test was performed which verified that the non-redundantly powered annunciators driven by ACA 2 were operational. It was therefore concluded that the problem was caused by either failure of both lamps or failure of the ACA channel which drives the B side of the ABORT annunciator. The decision was made to fly-as-is.

Post-flight troubleshooting at KSC revealed that one of the lamps was burnt out and the other did not illuminate due to dirty contacts. CONCLUSION: ABORT Light B did not illuminate due to failure of two lamps. CORRECTIVE_ACTION: The lamps were removed and replaced. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:17:23	Problem	**FIAR**	**IFA** STS-28-V-07	OMS/RCS
None	**GMT:** 222:06:00		**SPR** 28RF08	**UA**	**Manager:**
			IPR 32RV-0009	**PR**	
					Engineer:

Title: Forward Reaction Control Subsystem Vernier thruster F5L Heater Failed On. (ORB)

Summary: DISCUSSION: The forward Reaction Control Subsystem (RCS) vernier thruster F5L heater failed on while on-orbit. Plots of on-orbit temperatures showed that following a thruster firing, the temperature rose higher than the F5L heater system thermostat's upper temperature limit and this causes the thermostat to turn the heater off. In normal operation the temperature then decrease until it reaches the thermostat's lower temperature limit, at which time the thermostat turns the heater back on. The temperature then varies between the thermostat's upper and lower temperature limits. The F5R thruster temperatures did respond in this manner, indicating nominal operation of the thermostat and heater. However, the F5L thruster temperature, after exceeding the thermostat's upper temperature limit, never dropped below the thermostat's lower temperature limit, indicating that the thermostat had failed on. This failure had no effect upon the mission. The vernier heaters are of such low wattage that there is no concern if the thermostat is failed on for the entire mission.

CONCLUSION: The most probable cause of the forward RCS F5L heater to fail on was the failure of the F5L heater system's thermostat. CORRECTIVE_ACTION: The forward pod will be removed to replace the failed leaking F5R thruster (FPR STS-28-03), and at that time, the F5L thruster will be removed, repaired at KSC, and reinstalled. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. This failure is not considered to be generic.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:11:35	Problem	**FIAR**	**IFA** STS-28-V-08	C&T - S-Band
INCO-01	**GMT:** 222:00:12		**SPR** 28RF09	**UA**	**Manager:**
			IPR 32RV-0011	**PR**	
					Engineer:

Title: S-Band Power Amplifier 2 Showed Slowly Degrading RF Output Power (ORB)

Summary: DISCUSSION: The radio frequency (RF) output power amplifier (PA) 2 degraded slowly from 117 W at lift-off to approximately 64 W at landing. This degradation is indicative of the end-of-life for traveling-wave-tube (TWT) S/N 26 as has been experienced with failures of TWT's below S/N 57. Those TWT's have shown early cathode degradation after being operated in the standby mode for extended periods of time at high cathode temperatures, or have failed due to improper manufacturing processes.

No action was taken during the STS-28 mission as the rate of power-output degradation was low and communications via the Tracking and Data Relay Satellite (TDRS) were maintained satisfactorily. There was no need to switch from PA 2 to the redundant PA 1. The TWT boosts the 1 W output signal from the S-band transponder to 120 W and thereby, provides the required signal level at the TDRS. The TWT is a vacuum tube device that consists of a cathode and focusing devices which form an electron beam, and a helix structure where amplification of the RF signal takes place. The cathode emits electrons by heating barium which is produced by continuous chemical processes. It is a limited-life item with a theoretical life of 100,000 hours assuming ideal chemical processes during manufacture. Design operating life is 20,000 hours. There have been failures of Shuttle TWT's with operating hours as low as 2,000 hours. The failures have been attributed to two conditions. The first condition involved manufacturing defects where, as a corrective action, the use of a boroscope was incorporated for laser braze inspections on S/N 24 and later units, and use of improved cathode processing for S/N 57 and later units. The second condition resulted from an excessive cathode operational temperature setting which caused the development of a layer of barium zirconate between the cathode (nickel enriched with zirconium donor) and the electron emitting barium/thorium oxide cathode coating. The unwanted layer buildup process is gradual, but very much accelerated by a high-temperature cathode setting. This finding was supported by the failure analysis results of TWT S/N 44. During the STS-26 prelaunch processing, S/N 44 failed after only 2,000 hours of operating time. After a review of failures associated with TWT's similar to the Shuttle design, the TWT supplier determined that the initial design approach was flawed. To meet the high power requirements of Shuttle, the supplier had opted to use an existing lower power design and raise the cathode temperature to provide the additional power. Investigations of failures on a DOD program indicated that the temperature increase could destabilize the delicate chemical reactions that occur in the cathode materials and could result in premature aging and performance degradation that would eventually lead to a TWT failure. Consequently, the cathode temperature was lowered from 850?C to 780?C beginning with S/N 63. This step plus the changes in manufacturing processes discussed previously constitutes the new TWT -2XX configuration. The supplier recommended that all TWT's built before 1985 be returned to the supplier for lowering of the cathode temperature, if tests show that excessive damage has not already been done. The recommendation was not accepted since there are insufficient positive data to show that reducing temperatures, will significantly extend the TWT useful life. The power amplifier is redundant and loss of both TWT's is not a safety issue. There has never been a failure of both TWT's during a test or mission. The present plan is to continue using the existing TWT's in the field as is, but new TWT's

will be installed if the PA is returned to the supplier for any reason. Old TWT's, which are still operational, will be used for repair of non-flight units used in the Shuttle Avionics Integration Laboratory and the Electronics Systems Test Laboratory. Currently OV-102 and OV-105 have PA's with the new TWT's. The OV-103 PA has one new TWT and S/N 64 (2,441 hours of operation). The OV-104 PA has TWT's S/N 47 with 1,588 hours of operation and S/N 50 with 1,613 hours of operation. CONCLUSION: The most probable cause of PA 2 power degradation is early degradation of the TWT cathode. CORRECTIVE_ACTION: The PA has been removed, replaced and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 28RF09. EFFECTS_ON_SUBSEQUENT_MISSIONS: None expected. Degradation of PA output power is gradual, as shown by S/N 26 on STS-28, and can probably be used to complete the mission. Should a complete failure occur, the redundant PA can be used.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:20:33	Problem	**FIAR**	**IFA** STS-28-V-09	Water and Waste
EECOM-04	**GMT:** 222:09:10		**SPR** 28RF11	**UA**	Management System
			IPR 32RV-0010	**PR**	**Manager:**
					Engineer:

Title: Supply Water Dump Valve Failed Open (ORB)

Summary: DISCUSSION: During the fourth supply water dump at approximately 222:09:10 G.m.t., the supply water dump valve failed to close when commanded. The dump isolation valve was closed to terminate the dump, and was maintained closed for the remainder of the mission. Several more unsuccessful attempts were made to close the dump valve. The crew then performed an in-flight maintenance procedure (IFM) which purged the dump line with air. After the purge, the valve was again commanded closed with no success. For the remainder of the mission the supply water quantity was controlled using the flash evaporator system (FES).

Post flight troubleshooting revealed that the electrical continuity of the close command circuit was broken within the valve. The valve has been removed and replaced. Operation of the newly replaced dump valve will be verified per OMRSD V6AC0.020. A detailed analysis of the removed valve will be performed under CAR 28RF11. No other water valve in-flight problems have occurred as a result of electrical problems at the valve. CONCLUSION: The supply water dump valve failed open because of an electrical command path discontinuity. CORRECTIVE_ACTION: The valve has been removed and replaced. If the problem recurs on a future flight, supply water dumps can be terminated either by closing the dump isolation valve or the individual tank outlet valves and further dumps performed through the FES. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:17:09	Problem	**FIAR**	**IFA** STS-28-V-10	Star Tracker
GNC-03	**GMT:** 221:05:46		**SPR** 28RF12	**UA**	**Manager:**

IPR | **PR** GNC-2-A0012

Engineer:

Title: The -Y Star Tracker Annunciated a Pressurization Failure BITE (ORB)

Summary: DISCUSSION: Upon initial power up, a pressurization failure BITE was annunciated against the -Y star tracker (ST), indicating the internal pressure of the ST had dropped below 15.2 psia. This condition existed prior to flight and was detected during the ST self-test on July 17 (the OMRSD allows one flight of a ST following a pressure failure after which a purge and repressurization is required). This BITE was also annunciated against the same ST several months prior to the STS-28 launch and was subsequently cleared after repressurization.

The ST's are purged and pressurized to 17.2 psia with Argon gas to prevent moisture contamination from condensing on the lens and impairing performance. However, with the exception of the moisture concern, internal pressure does not affect ST operations. CONCLUSION: The most probable cause of the pressure failures is a leak in the large metal "C" ring seal in the head assembly of the ST. Leaks around this seal have been experienced in the past. CORRECTIVE_ACTION: Since this leak does not affect ST performance (provided purging and repressurization occurs prior to the next flight) and only one spare exists in inventory to support the next four flights, the -Y ST (S/N 003) will be purged and repressurized in place to support the next flight of OV-102. This ST will be removed and repaired when more spares become available or the unit experiences an operational failure. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:02:23	Problem	**FIAR** B-FCE-029-F012	**IFA** STS-28-V-11	GFE
EECOM-09	**GMT:** 224:15:00		**SPR**	**UA**	**Manager:**
			IPR	**PR** VJCS-2-09-0957	
					Engineer:

Title: Teleprinter Cable Short Circuit (GFE)

Summary: DISCUSSION: At about 224:15:00 G.m.t., the teleprinter cable experienced a short circuit between its 28 Vdc power and return conductors near the connector interface with Orbiter flight deck panel A15. The duration of the short circuit was approximately 1.6 seconds with an average current of about 30 amperes and maximum current spikes of approximately 50 amperes for 150 milliseconds. The 10-ampere breaker on MNC 016 did not trip because of insufficient total thermal energy. The short circuit terminated itself spontaneously. The crew reported seeing a flash and some floating particles, but took no action other than to open the circuit breaker and disconnect the cable from panel A15 after reporting the event. Some combustion products were recorded in the cabin by smoke sensors, but no alarm was set off.

While waiting the return of the failed cable at JSC, the alternate flight cable was examined. Upon removal of the Gortex sheathing in the same area where the other cable had shorted, both power wires were found to have broken insulation. Both conductors were fully exposed at the break points through 360-degree circumferential gaps in the Kapton insulation. The breaks were located at the back edge of the connector strain relief tang. The damage was apparently due to repeated sharp bending of the wires over the back edge of the tang. The failed flight cable was examined after its return to JSC. Both power wires were found completely severed and arc tracking of the Kapton insulated wires was evident. Approximately 1 inch of both wires were completely destroyed by melting and pyrolysis. Arc tracking had terminated approximately 1/2 inch from the connector pins where the two wires separated to enter the connector body. Although much of the evidence of the cause of the failure was destroyed, it is reasonable to conclude that the power conductors were exposed in a manner similar to that noted in the alternate flight cable, and this exposure allowed the short circuit to occur. As a result of the failure analysis, a design review was held to consider changes to the teleprinter cable. The following design changes were recommended and adopted. 1. Change to 90-degree backshells on all connectors so that wires do no have to bend sharply to be flush with interface panels. 2. Change to clamp-type backshells to accommodate strain-relief sheathing. 3. Change to Teflon insulated wire throughout the cable to improve its flexibility and its resistance to insulation fracture. New configuration cables were fabricated with 100-percent visual inspection, and then tested for continuity, isolation, and insulation integrity (Hi-Pot). CONCLUSION: The cause of the cable short circuit was insulation damage because of repeated sharp bending of the power wires over the back edge of the connector strain relief tang. This bending subsequently allowed the two exposed conductors to come into contact. CORRECTIVE_ACTION: The teleprinter cable, part no. SED18100071-302, S/N 1002, was removed and has undergone failure analysis. As a result of the analysis the teleprinter cable has been redesigned and new flight cables have been built. The new configuration cable, part no. SED18100071-303, has been baselined for all subsequent missions. In addition, the power conductors of all removable cables that carry spacecraft power will be Hi-Pot tested at 1500 volts prior to each mission. Hi-Pot testing will not be performed on pigtail cables. Cables which remain installed during turnaround shall be Hi-Pot tested when removed. The design of all cables have been reviewed for correct wire size, insulation material, strain relief, handling procedures, and proper installation. Some design changes are in work as result of the review. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-12	APU
None	**GMT:** Prelaunch		**SPR** 28RF14	**UA**	**Manager:**
			IPR	**PR** APU-2-08-0176	
					Engineer:

Title: APU 2 Fuel Isolation Valve B Open Indication (ORB)

Summary: DISCUSSION: During the auxiliary power unit (APU) console safing procedures prior to the prelaunch APU confidence run, the APU 2 fuel tank isolation valve B position indicator (V46X0234E) showed the valve to be in the open position after the closed command had been sent. The open indication remained throughout the mission. However, special tests performed before flight and before the APU's were shutdown after landing confirmed that APU fuel isolation valve B was functioning properly. This anomaly had no impact on the flight.

The failed-on valve status was visible to the crew on the APU 2 ready-to-start talkback on panel R2. This talkback should be in the barberpole position during APU prestart procedures until the crew placed the fuel tank valve switch to open. At that time, the talkback should go to the gray position if either fuel tank isolation valve A or B indicates open. Since the APU 2 valve B status was failed-open, the APU 2 ready-to-start talkback prematurely displayed gray before the fuel tank valve switch was moved to open. The valve-open indication is set by a microswitch that is mechanically connected to the valve poppet. Total travel of the microswitch is 0.006 inch, and total travel of the valve poppet is 0.012 inch. The valve seat is made of an elastomer which swells/distorts in hydrazine as a function of exposure time and manufacturing tolerances. The open indication is activated with 0.001-0.002 inch of microswitch movement, an amount considered consistent with the expected amount of seat swelling. An additional indication of seat swelling was the decreased differential pressure across the valve that was required to produce pressure relief in the reverse direction. This phenomenon is caused the reduced magnetic field that hold the poppet closed due to the increased distance of the poppet from its normal closed position. This same valve assembly unit displayed an identical failure during confidence runs prior to STS-27. The assembly was removed and vacuum baked. A subsequent leak check was within specifications and the open indication was no longer present. As a result, the valve assembly was returned to flight status and reinstalled in OV-102. CONCLUSION: The APU 2 fuel isolation valve B open indication was most probably the result of swelling of the hydrazine-sensitive valve seat. The isolation valve functioned properly throughout the mission with the exception that low back-pressure relief values were observed. CORRECTIVE_ACTION: The valve assembly will be flown as is for at least one more flight. A waiver to document all STS-32 OMRSD turnaround requirements affected by the failed-open indicator is being submitted. EFFECTS_ON_SUBSEQUENT_MISSIONS: The APU 2 fuel isolation valve B indicator will display open at all times during the next flight of OV-102 (STS-32) and subsequent OV-102 flights until the unit is removed and replaced.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-13	Water and Waste
EECOM-06	**GMT:** Prelaunch		**SPR** 28RF15	**UA**	Management System
			IPR 32RV-0027	**PR**	**Manager:**
					Engineer:

Title: Supply Water Dump Line Heater B Controlling Thermostat Failed (ORB)

Summary: DISCUSSION: Shortly after the crew switched from the side A to side B water line heaters during the redundant component checkout, the supply water dump line heater was noted cycling on and off between 90 to 110 ?F. These temperatures indicated that the over-temperature thermostat was controlling heater B. The controlling thermostat for heater B, which controls between 70 and 90 ?F and is in series with the over-temperature thermostat, would have to fail closed to allow the over-temperature thermostat to control. This failure represented no impact to the mission or crew safety, and had the over-temperature thermostat also failed, the heaters could have been switched back to side A.

CONCLUSION: The controlling thermostat for supply water dump line heater B failed closed.   CORRECTIVE_ACTION: The controlling thermostat will be removed and replaced. A failure investigation will be conducted on the failed thermostat and tracked on CAR# 28RF15.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-14	Atmospheric
EECOM-01	**GMT:** Prelaunch		**SPR** 28RF16	**UA**	Revitalization Subsytem
			IPR None.	**PR**	**Manager:**
					Engineer:

Title: Avionics Bay 2A Smoke Concentration Biased Low (ORB)

Summary: DISCUSSION: Prior to launch, the Avionics Bay 2A smoke detector indicated a negative smoke concentration value of less than -500 micrograms per cubic meter. The Launch Commit Criteria allowed the launch to proceed with one of two detectors in Avionics Bay 2 reading lower than -1000 micrograms per cubic meter; and as a result, this problem was not an impact to launch. A subsequent self test performed on this smoke detector showed that the detector was functional and that the negative readings were a bias. All other smoke detectors on the vehicle were operating within specifications.

After the flight, the Avionics Bay 2A smoke detector was removed and replaced. The new installed smoke detector will be verified through OMRSD requirement V62AP0.020. The removed smoke detector has been sent to the vendor for failure analysis.   CONCLUSION: The Avionics Bay 2A smoke detector exhibited a biased low smoke concentration reading, but the detector was still functional during the flight.   CORRECTIVE_ACTION: The smoke detector has been removed and replaced. The vendor is performing a failure analysis of the removed smoke detector.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 003:13:00	Problem	**FIAR**	**IFA** STS-28-V-15	Active Thermal Control
EECOM-08	**GMT:** 224:01:37		**SPR** 28RF17	**UA**	Subsytem
			IPR 32RV-0028	**PR**	**Manager:**
					Engineer:

Title: Freon Flow Degradation During Low Temperature Radiator Operation (ORB)

Summary: DISCUSSION: The radiators were exposed to temperatures below -60?F while performing a detailed test objective (DTO) during the mission. At these low temperatures, freon loop 2 experienced a 100 lb/hr flow degradation and freon loop 1 experienced a 50 lb/hr flow degradation. These flow degradations did not affect crew safety or mission success. The flow rates returned to normal as the radiators reheated.

This phenomenon was initially attributed to excess water in the freon that could freeze into ice at the low temperatures experienced, and the ice could produce a flow restriction. Freon samples were taken from each of the loops during postflight turnaround operations. The water content in the freon loop 1 sample was 11 to 12 ppm and the water content in the freon loop 2 sample was 9 ppm. Both freon loop samples were below the maximum specified water content (15 ppm, which corresponds to water separation temperature of -85?F), and therefore, did not contain enough water to support the freezing theory. Flow restrictions in the flow control valve of the radiator flow controller assemblies (RFCA's), possibly related to the generic low freon flow phenomenon on OV-102, are now thought to be the cause of the increased flow degradation at low temperatures. The RFCA for freon coolant loop 2 was removed and replaced as part of the fix for the generic flow problem. Normal freon flowrate in loop 2 was increased by approximately 20 percent after removing and replacing the RFCA and the flow proportioning valve. The removed RFCA will be tested in mid-December to determine if a restriction exists in the flow control valve which could have caused the extra flow degradation at low temperatures. CONCLUSION: The freon flow degradation at low temperatures was most likely caused by flow restrictions within the flow control valve of the RFCA's. CORRECTIVE_ACTION: The RFCA for freon coolant loop 2 has been removed and replaced. The removed RFCA will be flow tested to determine if a flow restriction exists within the flow control valve. If the problem recurs on further flights of OV-102, it will have no impact on mission success or crew safety. EFFECTS_ON_SUBSEQUENT_MISSIONS: Possible similar degradation of freon flow at extremely low radiator temperatures. No impact on mission success or safety.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:01:00	Problem	**FIAR**	**IFA** STS-28-V-16	C&T - Navaids
GNC-04	**GMT:** 225:13:37		**SPR** 28RF20	**UA**	**Manager:**
			IPR 32RV-0013	**PR**	
					Engineer:

Title: Radar Altimeters Lost Lock (ORB)

Summary: DISCUSSION: Radar altimeters (RA) 1 and 2 lost lock at 225:13:37 G.m.t., at an indicated altitude of 26 feet above the runway (main gear approximately 5 feet above runway). RA2 regained lock 11 seconds later at 19 feet, and RA1 regained lock 13 seconds later at 13 feet.

The radar altimeter gain adjustment for lower altitudes is very critical because of the possibility of lock-on to the antenna-leakage signal, if the gain setting is too high. Postflight testing at KSC revealed the gain settings on both of the OV-102 units to be marginally low. The marginal gain setting, the higher-than-normal Orbiter pitch angle just prior to touchdown, and the dry lakebed (lower RF reflectivity than concrete) were all factors that could have contributed to the loss of lock. Troubleshooting also revealed that the zero-adjust procedure following installation of an altimeter in the Orbiter may also have had an effect on the gain-sensitivity settings. A similar problem occurred on STS-26 (OV-103) (reference Flight Problem Report STS-26-16). Following this anomaly, all radar altimeters were gain-adjusted, however, the OV-103 and OV-104 units had already gone through zero-adjust. The OV-104 units subsequently performed without problems on STS-27, which was also a lakebed landing.

No anomalies were noted on either STS-29 or STS-30, however, these landings were on the concrete runway. CONCLUSION: The loss of lock was caused by marginal low altitude gain sensitivity settings in combination with the landing attitude and lakebed-runway conditions. CORRECTIVE_ACTION: With the exception of the units installed in OV-104 (demonstrated good lakebed performance) and in OV-103 (checked by the vendor and found to have proper gain settings), all radar altimeter units (including spares) are being readjusted by the vendor using refined procedures. Additionally, the zero-adjust procedure performed during radar altimeter installation has been modified to preclude the negative effects on the gain settings. A redesigned antenna with improved leakage characteristics will be utilized on OV-105. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 005:00:02	Problem	**FIAR**	**IFA** STS-28-V-17	OMS/RCS
PROP-06	**GMT:** 225:12:39		**SPR** 28RF21	**UA**	**Manager:**
			IPR 32RV-0025	**PR**	
					Engineer:

Title: The Right Hand Orbital Manuevering System Fuel Quantity Gauge Read Higher Than Predicted During The Deorbit Burn (ORB)

Summary: DISCUSSION: The right hand Orbital Manuevering System (OMS) fuel quantity gauge read 5.7 percent higher than predicted during the deorbit burn. The slope of the quantity plot was essentially the same as all other quantity gauges during on-orbit burns which would imply that there is a constant bias in the gauging system. Quantities indicated on-orbit were within predicted margins.

CONCLUSION: The fuel quantity indicated by the fuel gauging system at the end of the deorbit burn was higher than expected; however, the fact that the rate of fuel depletion was close to expected values implies that the aft probe may have developed a leak. Post-flight troubleshooting at KSC revealed an anomalous output from the probe. CORRECTIVE_ACTION: During flight, the quantity can be accurately determined by use of burn time computations. During ground operations, if the fuel gauging system fails completely, alternate loading procedures can be used during tank fill operations to determine the quantity. Also, since repair of the fuel gauging system requires removal of the pod, no immediate action is recommended until the pod is removed for some other required repair or maintenance. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 005:00:28	Problem	**FIAR**	**IFA** STS-28-V-18	APU
None	**GMT:** 225:13:05		**SPR** 28RF22	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: APU 1 Test Line Temperature High (ORB)

Summary: DISCUSSION: After auxiliary power unit (APU) 1 was started during entry operations, a fault detection annunciation (FDA) alarm was received by the backup flight system (BFS) because APU 1 fuel test line temperature 1 (V46T0183A) rose above the FDA limit of 90 ?F to 92 ?F. Upon reception of this message, the crew switched from the B system to the A system heaters because of the possibility of a failed-on heater.

A modification was made to all vehicles after STS 51-L that relocated the temperature sensors for this heater (V46T0183A and V46T0184A) from a clamp on the line to the actual line. This change was made to prevent a clamp failure from causing the loss of the measurements and the resulting loss of insight into heater operation. This change made the sensor more sensitive to the heater, and as a result, this measurement has exceeded the 90 ?F FDA limit on every flight since STS-26. A preplanned procedure to increase the FDA limit for this measurement from 90 ?F to 95 ?F in both the Primary Flight System (PFS) and the BFS via table maintenance block update (TMBU) had been executed on all flights since STS 51-L except STS-28. On this flight, only the PFS FDA update was accomplished. The BFS FDA change was not made, thus allowing the BFS alarm to be received. CONCLUSION: A BFS FDA alarm was received on the APU 1 fuel test line temperature 1 because a TMBU to increase the FDA limit from 90 ?F to 95 ?F was not performed. This limit increase is necessary because the temperature sensor has been moved to a location where it experiences a warmer environment. CORRECTIVE_ACTION: A permanent FDA limit change for this measurement will be incorporated with an STS-36 effectivity. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-28-V-19	CREW
None	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR	**PR** FCS-2-09-0240	
					Engineer:

Title: Rubber Grommet on Wet Trash Volume Came Loose (ORB)

Summary: DISCUSSION: The rubber grommet, which restrains the wet trash by covering the opening in Volume F, came off while the crew was stowing wet trash. However, the wet trash was adequately restrained during the rest of the mission by the Volume F door.

After the flight, the grommet was recovered and cleaned. No damage to the grommet or the Volume F opening was noted. The resiliency of the grommet was compared to with resiliency of the OV-103 grommet and no difference was noted. The grommet was then reattached to OV-102 and the fit was compared with that of OV-103, again no differences were noted. After the grommet was reseated, several attempts were made to dislodge it by simulating the insertion of trash in a person's hand. The grommet could not be dislodged by the normal motion of inserting trash into Volume F, but could be dislodged if off-nominal forces were used. Since the grommet was firmly reattached, showed no evidence of damage, and this was the first time a grommet had become detached, the grommet will be flown as-is for the next mission of OV-102. If the problem recurs, the grommet can be reattached by the crew, or in the worst case, wet trash can still be adequately restrained using the Volume F door. CONCLUSION:

The rubber grommet came loose from the Volume F opening due to the apparent exertion of off-nominal forces on the grommet or the inadequate attachment of the grommet to the Volume F opening.   CORRECTIVE_ACTION: The grommet was reattached to the Volume F opening. Fly as-is.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR** B-FCE-023-F005	**IFA** STS-28-V-20	GFE
None	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: High Iodine Concentration in Drinking Water (GFE)

Summary: DISCUSSION: The crew measured iodine levels in the drinking water as high as 13 ppm during the mission. Concentrations of 2 to 5 ppm are desired. During debriefing, the crew reported that the iodine in the water was so distasteful that by the end of the mission only food that did not require rehydration was eaten. Also, during the pre-deorbit water loading, one crewman physically could not drink all of the required water because of the high iodine content.

This phenomena is identical to that experienced on STS-30 and reported on Flight Problem Report STS-30-23. The cause of the problem was that the supply water temperature was warmer than the temperature used for the design of the microbial check valve (MCV), causing the MCV to inject excess iodine into the water. The iodine concentration measurements taken on STS-28 were part of an effort to obtain data supporting a redesign of the iodine injecting resin of the MCV's, thereby correcting the problem. However, the redesigned resin will not be available for about 6 more months. Following the STS-28 flight, a short-term fix was initiated and is being implemented for STS-34. The short-term fix will require installing an additional MCV at each of the chilled water and ambient water ports of the galley where the water temperatures are between 45 and 80 ?F. Test data have shown that by flowing cooler water, these downstream MCV's will actually absorb any excess iodine injected by the original upstream MCV which is flowing water at the higher temperatures. This fix can be accomplished by clamping the new MCV's to the galley structure and plumbing them with flexible quick-disconnect lines, thus no permanent modifications to the galley will be required.   CONCLUSION: A high iodine concentration was experienced in the drinking water because the supply water was warmer than the temperature used for the design of the MCV's, causing excess iodine to be injected into the water.   CORRECTIVE_ACTION: A temporary change in which additional MCV's will be added at the galley to absorb excess iodine will be implemented starting with STS-34. For the long term, an effort is underway to redesign the MCV resin to inject the proper amount of iodine into the warmer water. This redesign effort will be complete in about 6 months.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-28-V-21	ECLSS
None	**GMT:** Postlanding		**SPR** None	**UA**	**Manager:**

			IPR 32RV-0033	**PR**	
					Engineer:

Title: Crew Experienced Sneezing Near Windows 1 and 2. (ORB)

Summary: DISCUSSION: During the postflight debriefing, the crew stated that they had all experienced sneezing symptoms when they were near windows 1 and 2 (Commander's side).

Samples from the middeck-mounted onboard gas sampler were analyzed at JSC, and no constituents were found that would cause sneezing. Air samples and swab samples were taken from the crew compartment upon the Orbiter's return to KSC. Samples were taken from windows 1 and 2, the air ducts near these windows, other portions of the Commander's quadrant, and the middeck. Samples were taken both prior to power up (no fans running) and after power up (fans running). No anomalous microbial or chemical elements were found in these samples and none of the personnel who took the samples experienced any sneezing symptoms. However, this lack of results may have resulted from purge air having been on the crew compartment prior to sampling, possibly removing whatever material that had caused the sneezing. The window shades and all metal and fabric surfaces around windows 1 and 2 were inspected for contaminants which may have caused the sneezing. No stains or odors were noted on any of these surfaces. The inspecting personnel did not experience sneezing symptoms. The lithium hydroxide (LiOH) canisters used on this flight were emptied and samples of the contents of each were sent to JSC for analysis. Since the LiOH canisters contain a charcoal filtering agent, anomalous substances that were in the cabin could have been filtered out into the LiOH canister. No anomalous constituents were found in the LiOH samples. No modifications or material replacement were performed on windows 1 and 2 between this flight and the previous flight, which rules out outgassing from new window materials as a cause of the sneezing. CONCLUSION: The cause of the crew's sneezing near windows 1 and 2 is unknown. Reported crew sneezing had no effect on crew operations or mission effects. CORRECTIVE_ACTION: Upcoming crews will be advised to use the presently manifested air sample contained to take a sample when and where the sneezing symptoms are experienced, should the problem recur. In addition, crew will be advised to mention the problem on air-to-ground communications when it occurs, so personnel can be ready to take samples immediately after landing. Medical Sciences personnel will attempt to have an extra air sample container and a solid sorbent sampler manifested on future flights to aid in troubleshooting any similar problems. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-22	GFE
None	**GMT:** Prelaunch		**SPR** None	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: Umbilical Well Camera Inoperative (GFE) (GFE)

Summary: DISCUSSION: The 16-mm motion picture camera with a 10-mm lens, mounted in the umbilical well to photograph External Tank thermal protection system damage, stopped functioning approximately 1.5 seconds after activation during ascent. An identical camera with a 5 mm lens that is also mounted in the umbilical well performed satisfactorily.

The film was loaded into the camera 50 days prior to launch. For previous missions, these cameras were loaded approximately 2 weeks before launch. Once the film is loaded in the camera, the film begins taking permanent "sets" or bends in the locations where the film bends around rollers and guides. Over a period of time, these sets may become severe enough to cause the film to jam or break when the camera is operated. The film vendor initially recommended use of the film within 3 days of loading or running the camera for a short period of time ("burping") every 3 days to prevent the film from taking a set. Subsequent analysis by JSC and the vendor extended the maximum time interval for "burping" the film to 45 days. On the 44th day after loading, both umbilical well cameras were "burped" for 1 second. An agreement was reached between JSC and KSC for the STS-32 mission where the film will be loaded only 30 days prior to launch, thus reducing the chances of breakage.
CONCLUSION: The 16 mm camera acquired on 1.5 seconds of launch photography because the film broke 1.5 seconds after the camera was activated during ascent.
CORRECTIVE_ACTION: Film for these cameras for the STS-32 mission will be loaded 30 days prior to the planned launch date to decrease the probability of the film developing a "set" that could result in the film breaking.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:19:00	Problem	**FIAR**	**IFA** STS-28-V-23	Hydraulics
None	**GMT:** 221:07:37		**SPR** 28RF06	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Hydraulic System 2 Unloader Valve Operation Out of Specification (ORB)

Summary: DISCUSSION: The hydraulic system 2 unloader valve cycled at the 2350-psi accumulator pressure level, which is high, during prelaunch operations. During flight, the accumulator pressure level dropped sharply from 2500 psi to 2350 psi, a value which is also high. The specification requirement is 2100 psi +0, -100 psi. The unloader valve cycles to be in a position for recharging the bootstrap accumulator fluid leg, if and when the respective circulation pump is commanded on.

CONCLUSION: Suspect valve leakage and stiction caused by foreign particle contamination and/or valve wear caused the valve to cycle out-of-specification. The accumulator pressure decay signatures are an indication of an improperly seated pilot valve ball. This valve configuration (MC284-0438-0001) has a history of particle contamination and pilot valve ball damage.   CORRECTIVE_ACTION: An existing valve upgrade (-0002) configuration has been approved for implementation on an attrition basis. This upgrade adds a filter (15-micron nominal/25-micron absolute) at the accumulator port and changes the pilot valve seat area. Both of these changes should prevent contamination from entering the pilot valve and reduce wear on the pilot valve seat and ball area. KSC will remove the present unloader valve and replace it with a -0002 configuration. The removed valve will be sent to the vendor for failure analysis and upgrading to a -0002 configuration. Once the valve is upgraded, it will be acceptance tested and sent back to KSC for use as a spare. EFFECTS_ON_SUBSEQUENT_MISSIONS: The -0001 unloader valve configuration will continue to be upgraded on an attrition basis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:01	Problem	**FIAR**	**IFA** STS-28-V-24	STR
None	**GMT:** 220:12:38		**SPR** 28RF07	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Ground Film Revealed Apparent Body Flap Motion during Ascent. (ORB)

Summary: DISCUSSION: Approximately 18 seconds after lift-off and again 28 seconds later, ground based film shows apparent body flap motion. Photo analysis indicates the amplitude of the motion is approximately 6.1 +/- 3.0 inches peak-to-peak at a frequency of 7.5 Hertz. As a result of this analysis, three tests have been performed to determine the structural integrity of the OV-102 body flap.

The first test, a detailed borescope inspection, was performed and did not reveal any irregularities. The second test, a static freeplay test, was performed and a freeplay of about 0.500 inches peak-to-peak was measured at the trailing edge. The maximum allowable deflection is 0.970 inches. In comparison, the OV-103 freeplay test measured 0.880 inches. The third test, a modal analysis, was performed on OV-102 and OV-103 body flaps. Modal tests were performed on both vehicles as no previous test data were available for the Orbiters in their present configuration. These tests indicate the OV-102 and OV-103 body flap structures are sound. Although there were some differences in the test data between OV-102 and OV-103 these differences are not considered a constraint to flight. Investigations continue, by the Structures and Mechanics Division, to better understand these differences. Finally, ground based film reveals similar apparent motion during the STS-34 (OV-104) and STS-33 (OV-103) flights. CONCLUSION: The maximum expected amplitude, for the predicted forces encountered during the ascent phase, is 4 inches peak-to-peak which is within the error band of the inflight findings of 6.1 +/- 3.0 inches. If the amplitude was greater than 4 inches, the most plausible explanation would be freeplay in the rotary actuators. Although the Orbiter and GFE Projects Office believes that the large motion observed was the result of an aberration (first time this type of lens and film used to record this view), the body flap actuators will be removed and the acceptance test procedure (ATP) performed to insure the actuators still meet specifications. CORRECTIVE_ACTION: The two port actuators were replaced with new units (to save turnaround time). The ATP was performed on the two starboard actuators, both passed and have been reinstalled on the vehicle. A detailed inspection of the attachment points did not reveal any irregularities. The three OV-102 body flap accelerometers have been reattached for STS-32 and subsequent flights. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-28-V-25	C&T
None	**GMT:**		**SPR** 28RF28	**UA**	**Manager:**

IPR 32RV-0020 **PR**

Engineer:

Title: Network Signal Processor Frame Synchronization Errors (ORB)

Summary: DISCUSSION: The network signal processor 2 (NSP 2) and communications security unit 2 (COMSEC 2) experienced frame synchronization errors (dropouts) during prelaunch operations. The condition was determined to be a ground problem by the launch team and the launch countdown continued. During launch, some intermittent short-duration data dropouts occurred at three ground stations - MILA, Bermuda, and Indian Ocean. These short-duration data dropouts have been experienced on previous missions and are not an NSP-unique problem. None of the data dropouts significantly impacted launch or mission operations. The above anomalous conditions were also experienced during prelaunch and launch of STS-34 (OV-104) and STS-33 (OV-103).

Postflight data review indicated that the NSP performance was nominal during the on-orbit period and during operations through the Tracking Data Relay Satellite System (TDRSS). During OV-102 postflight troubleshooting operations, an attempt was made to duplicate the problem by transmitting to NSP 2 the recorded ground-station command data tapes containing the data that was present when the prelaunch condition occurred. The test was not successful because the quality of the second generation data tape was seriously degraded. Real-time encrypted uplink front end processor data was then transmitted to the vehicle using the radio frequency (RF) link through the S-band upper left quad antenna. No frame synchronization dropouts were detected during a monitoring period of 2 hours 45 minutes. NSP 1 was then selected, monitored for 30 minutes, and again no dropouts were detected. The troubleshooting data indicated that the anomaly observed during prelaunch activities did not result from a vehicle problem. During ground operation, all critical commands are transmitted via copper paths and monitored via the Launch Processing System (LPS). In addition, all other commands transmitted during launch via the RF network are verified and can be re-transmitted should frame-synchronization-error occur. Based on the troubleshooting activities, it was concluded that the most likely cause of the NSP 2 frame synchronization dropouts was multipath RF reflections from the atmosphere or ground objects. However it is possible that a generic incompatibility exists between the NSP and the RF network. For a full understanding of the NSP data dropouts, several measures have been established: a. KSC will monitor the data dropout rates during operations at launch pad A versus operations at launch pad B to verify the multipath theory. b. An engineering support request has been submitted to add a ground RF monitoring system at the launch pad to record the signals as seen by the vehicle. c. The real-time coordination between the local network ground station and KSC operations personnel will be improved for a more timely identification of data dropouts. d. A special team with JSC, KSC, and Goddard Space Flight Center membership has been established to investigate a possible network-to-NSP generic incompatibility problem. The NSP frame synchronization dropouts are monitored by the ground launch sequencer (GLS). A launch commit criteria (LCC) change is being submitted to allow for multipath induced data discrepancies during the monitoring period. Since the full resolution of this problem requires a multicenter effort and since no significant impact to prelaunch or launch operations currently exists this problem is closed for the Orbiter and has been referred to the Shuttle TDRSS Operating Procedures Working Group (STOPWG) for study and recommendations for corrective action. CONCLUSION: When the NSP 2 is provided with a known reliable and controlled uplink RF and data source, it responds as expected. The most probable cause of the NSP-2 frame synchronization error was an RF multipath condition. The possibility of a network-to-NSP generic imcompatibility problem exists. CORRECTIVE_ACTION: Corrective actions are enumerated under Discussions section. EFFECTS_ON_SUBSEQUENT_MISSIONS: Nuisance data dropouts

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-28-V-26	TPS
None	**GMT:** Postlanding		**SPR** None	**UA**	**Manager:**
			IPR	**PR** STR-2-09-2301, MEQ-2-09-0305	**Engineer:**

Title: Possible Orbiter Structural Heat Damage (ORB)

Summary: DISCUSSION: During the post-landing tile inspection at Edwards Air Force Base, evidence of heat/slumped tile damage (located near the aft right external tank (ET) umbilical door frame structure) was noted. Also, the forward and aft right-hand ET umbilical door hinges showed evidence of room-temperature vulcanized (RTV) silicone deposits, which was interpreted by ground personnel as exposure to high temperatures. This interpretation raised concerns about the possibility of burn through. The tile was removed and a structural inspection was completed with no structural damage reported.

CONCLUSION: The presence of RTV silicone deposits (due to outgassing) is considered a nominal occurrence in this area. This is due to te presence of the ET door thermal barrier, which is coated with RTV by design. Launch Operations at KSC indicated that most of the RTV deposits were present before the STS-28 flight. The TPS engineering community has reviewed the evidence and is in agreement that no burn through or overheating occurred. CORRECTIVE_ACTION: The damaged tile will be replaced. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-28-V-27	GNC
None	**GMT:** Prelaunch		**SPR** None	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: Thump at Transition to OPS 101. (ORB)

Summary: DISCUSSION: During the post-flight crew debriefing the crew reported that they felt a significant "thump" which shook the vehicle during the prelauch period. The crew reported that it occurred at the time of the first transition to major mode 101. (A recycle to G9 and subsequent transition was required due to an unrelated anomaly.)

Postflight investigation of this anomaly centered around the flight control system because the only anticipated motions at this time are movement of the elevons which are driven to the null positions with hydraulic circulation pump pressures. This is a normal occurrence when the flight control system becomes active at OPS transition, assuming the elevons have experienced drift from the last time they were positioned (also a normal occurrence). In this case, the elevons had drifted by amounts ranging from 2 to 7 degrees. Data indicate that hydraulic pressures were stable at 500 psia prior to transition and that a drop to approximately 100 psia occurred in response to elevon step commands at transition. Hydraulic pressures recovered as the elevons were being driven at approximately 2.3 degrees per second to the commanded position. Comparison with previous flight data indicates that this is a normal signature. Available vehicle rate and accelerometer data were analyzed. Compensated vehicle rate data derived from gyros in the aft bay indicated normal random bit toggling during this time frame, but not discernable rates. Selected lateral and normal accelerometer data from the forward bay also indicated single-bit toggling, that appeared to be in response to elevon motion. The scale factor (0.008 g per count in normal axis) could be perceptible by the crew, but would not be considered a major shock. Data associated with the body flap, rudder/speedbrake, and TVC actuators were also examined, and no anomalies were noted. Data from ground based instrumentation (acoustical microphones and launch-pad accelerometers) were examined, and revealed no anomalous signatures. High-resolution development flight instrumentation (DFI) strain gauge data were not available for analysis since the MADS recorder was not in operation at the time of the anomaly. However, as a result of this anomaly, the MADS was activated during OPS transition for the STS-34 and STS-33 countdown activities. Data analysis revealed no abnormalities.Consideration was given to possible binding of the rub strip on the trailing edge of the elevon flipper-door seals. Inspection revealed no anomalies, and OV-102 has subsequently undergone successful flight control system frequency response testing. Consideration was given to possible binding of the rub strip on the trailing edge of the elevon flipper-door seals. Inspection revealed no anomalies, and OV-102 has subsequently undergone successful flight control systems frequency response testing. Consideration was also given to the following non-flight-control-systems which might have experienced a phenomena coincident with (but unrelated to) OPS transition: 1. There were no purge vents made during this time period. 2. The white room is not retracted until approximately T-7.5 minutes. The white room-to-vehicle seal is an air bag and would not be conducive to transmitting a shock. 3. No coincident occurrences were noted in the ECLSS, RCS/OMS, Fuel Cells, or PRSD systems. 4. There were no payload events at this time. Previous crews have reported no such sensation at OPS transition. Subsequent crew members have reported that elevon motion was perceptible, but there was no major shock. CONCLUSION: The cause of the thump is unknown. It was most likely related to elevon positioning, but the specific source cannot be determined from available information. The anomaly had no apparent effect on the subsequent performance of the vehicle. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-28-V-28	MPS
None	**GMT:**		**SPR** 28RF29	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: MPS GH2 Flow Control Valve E1 Sluggish (ORB)

Summary: DISCUSSION: The main propulsion system (MPS) gaseous hydrogen (GH2) flow control valve (FCV) E1 exhibited sluggish behavior throughout ascent. On several cycles, the valve did not stroke fully from the closed (low flow) to the open (high flow position. Delayed responses to the close command and sluggish responses during opening and closing operations were observed on several cycles. When commanded to move while the Space Shuttle main engines (SSME's) were throttled down during the thrust bucket, the valve did not respond at all. The operation of GH2 FCV's E2 and E3 was nominal, and the liquid hydrogen ullage pressure stayed within the required 32- to 34-psi control band. The sluggish behavior of FCV E1 had no effect on the flight.

All three GH2 flow control valves were removed and inspected during postflight turnaround activities. While contamination was found in each valve, FCV E1 contained significantly more contaminants than E2 or E3. The source of this contamination is under investigation. It has been determined, however, that the contamination is not valve material. A major portion of the contamination is composed of low 300-series stainless steel. This material is not used in the Orbiter/MPS GH2 system, but is used in the SSME's. The sleeve-to-seal clearances on FCV's E1 and E3 were measured to be 0.0007 to 0.0009 inch and 0.0005 to 0.0007 inch, respectively. Requirements state a minimum clearance of 0.0008 to 0.0009 inch. The GH2 FCV's thermal environment throughout flight is relatively stable, experiencing a localized temperature range of 0 +/- 20?F. It is not believed that this temperature range caused any thermal distortion which affected FCV operation.   CONCLUSION: The sluggish behavior of FCV E1 was most probably caused by a combination of contamination and an out-of-specification (too tight) sleeve-to-seal clearance.   CORRECTIVE_ACTION: FCV's E1 and E3 were returned to the vendor where their sleeves were remachined to achieve an in-specification sleeve-to-seal clearance. The valves were then successfully tested and reinstalled on OV-102. The OV-102 MPS underwent several blowdowns and the 2-inch pressurization line was flushed to meet cleanliness requirements. File III OMRSD requirements have been modified to include current signature testing of the GH2 FCV's for the next five flows of every vehicle. To provide for quicker identification of GH2 FCV anomalies, a change request is being submitted to change the downlink rate of the GH2 FCV inlet pressure from the current 1 sample-per-second to 10 samples-per-second in the normal ascent telemetry format load (166).   EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-28-V-29	MPS
None	GMT:		SPR 28RF30	UA	Manager:
			IPR None	PR	
					Engineer:

Title: Apparent GO2 Manifold Pressure Lag During Entry (ORB)

Summary: DISCUSSION: When helium repressurization of the main propulsion system (MPS) liquid oxygen (LO2) and gaseous oxygen (GO2) manifolds was initiated during entry, the pressure rise in the GO2 prepressurization/pressurization manifold appeared to lag the pressure rise in the LO2 manifold. These pressures should increase concurrently. This anomaly had no impact on the mission.

The apparent lag in the pressure lag was due to a combination of pressure-data reporting peculiarities. First, the GO2 pressure transducer was found to be biased low by approximately 8 psi. This transducer's operating range is 0-1000 psi. Since it is allowed a 3 percent error, the observed 8-psi bias is well within specification. Second, the lowest manifold pressure that is downlisted is zero psi. Thus, when the entry LO2/GO2 pressurization began, the downlisted manifold pressure remained at zero psi until the actual pressure was 8 psi. At this time, the downlisted pressure began to rise, giving the impression of a pressure lag. Three manifold repressurizations were performed during Dryden postlanding operations and each showed the manifold pressure rise rate to be nominal. An actual blockage of a manifold repressurization system can be determined by the pressure rise rate. Since the ground pressurizations were nominal, the possibility of a blockage was eliminated. An anomalous blockage condition was present on OV-104 flight 4 (STS-30-22). CONCLUSION: The apparent slow rise in pressure in the MPS GO2 prepressurization/pressurization manifold when compared to the rise in the LO2 manifold was most probably misleading data caused by a GO2 pressure transducer bias in combination with the downlisted pressure being truncated at zero psi. The actual manifold pressure rise was nominal. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-28-V-30	GNC
None	GMT:		SPR 28RF31	UA	Manager:
			IPR None	PR	
					Engineer:

Title: Early Transition to Turbulent Flow During Entry (ORB)

Summary: DISCUSSION: During entry, unusual low-frequency aileron motion was observed for a 5-minute period beginning at approximately Mach 19 (first roll reversal) and continuing through approximately Mach 11. Postflight analysis of flight control and aerodynamic data from that time period revealed the following:

1. A continuously changing amount of aileron trim was required during the time period. The change was characterized by a long sinusoid period which peaked at approximately 0.5 degree. Although this was greater than normal, adequate control margins may be maintained with trim settings up to 3 degrees. 2. An increase in yaw thruster activity was also noted. The direction was consistent with the direction of the trim settings. Total reaction control system (RCS) usage was slightly high (850 lbs), but well within budget (1250 lbs). RCS usage for previous flights with similar profiles was 610-700 lbs. 3. Data indicate that transition from laminar to turbulent flow conditions occurred on the mid and aft portions of the vehicle at 900 seconds after entry interface, or at approximately Mach 18. Flow transition normally occurs between Mach 8 and Mach 12. This was derived from surface temperature profiles during entry. These temperatures were approximately 200?F hotter than normal. Temperature measurements near the nose indicate that transition occurred in this region approximately 1215 seconds after entry interface, which is normal-to-late. Structural bondline temperature differentials (between orbit and postlanding) were 20 to 30?F greater than those observed on mission with comparable trajectories (STS-9). Analysis indicates that if boundary layer transition occurred sooner on the left side of the vehicle than on the right side, asymmetric drag and an associated yawing moment would result. Simulations conducted with the above asymmetric drag conditions indicate that the flight control system responded as could be expected in the presence of such an external force, and was well within control margins of RCS budgets. The most significant effect of early boundary layer transition is increased surface temperatures for longer periods of time in regions where flow is turbulent. This will result in a higher incidence of heat damaged tiles and filler bar charring. Postlanding vehicle inspections revealed protruding tile gap fillers. Two protrusions were noted on the forward left fuselage bottom near location X/L = 0.3. Additional protrusions were noted on the aft fuselage bottom, and there were several instances of missing gap fillers. These gap filler protrusions could cause early boundary layer tripping, and their locations are consistent with thermocouple locations which indicated initial tripping. OV-102 required a significantly greater number of gap fillers than usual to be installed out-of-station (in the VAB or on the pad) which is a less controlled environment than in the OPF. Debonding of gap filler material can occur as a result of incorrect adherence to

installation procedures.   CONCLUSION: The unanticipated flight control system behavior was a normal response to sideslip conditions induced by early boundary layer transition and resulting asymmetric drag. The flight control system operated well within design capabilities with respect to control margins and RCS usage. The early boundary layer transition was most probably caused by the protruding TPS tile gap fillers. The cause of the missing and protruding tile gap fillers is most probably related to workmanship during gap filler installation. Early boundary layer transition is not a safety-of-flight concern as performance was well within flight control margins, and heating effects were well within thermal constraints.   CORRECTIVE_ACTION: None. Existing thermal protection system installation and repair procedures are adequate to protect safety-of-flight.   EFFECTS_ON_SUBSEQUENT_MISSIONS: Recurrence will resutl in a higher incidence of thermal protection system damage.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-28-V-31	MPS
None	**GMT:** Postlanding		**SPR** 28RF33	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Loose Foam on ET, LO2 Umbilical (ORB)

Summary: DISCUSSION: The Orbiter External Tank (ET) well separation camera showed loose foam along the forward portion of the liquid oxygen (LO2) umbilical. The displaced thermal protection (TPS) piece was estimated 18 inches wide by 8 inches long and 2 inches deep. This TPS foam was loosely attached by the fire barrier coating. Photo coverage was only available on OV-099 and OV-102. Less significant damage has been recorded on STS-4, STS-9 and STS-61A on the LO2 forward ET umbilical.

There are no known forces that will accelerate the debris toward the Orbiter. There is an extremely remote change of foam debris traveling into the umbilical cavity while the Orbiter relative movement is away from the ET. Previously photographed flight damage also indicates that the majority of the foam is contained as opposed to breaking loose. Also, ET Umbilical Doors can be recycled in-flight, if closing or latching is impeded. Analysis of umbilical foam indicates an approximate shear load of 2000 lb is required to cause damage similar to STS-28. An existing enhancement which adds a polyurethane coating will increase the calculated shear load to 4400 lb. The STS-28 umbilical did not have this protective coating.   CONCLUSION: The source of the damaged foam is unknown, but umbilical foam debris is not considered a safety to flight concern.   CORRECTIVE_ACTION: An existing enhancement which adds a protective polyurethane coating provides additional strength to the umbilical foam. The change was implemented to minimize handling damage. Future umbilical sets will have this additional coating with the exception of STS-32, -41, -43, and -44. EFFECTS_ON_SUBSEQUENT_MISSIONS: Minimal risk in using umbilicals that do not have protective clear coating based on the above rationale and past performance of the ET umbilical foam.